Rotation Periods of the Markings on Jupiter.

By W. F. Denning.

It seems desirable to trace, as closely as possible, the markings on *Jupiter* at successive oppositions, so that the changeable velocities of the different currents may be determined and compared. By this means it will ultimately become possible to ascertain whether the motions are subject to regular periodical variations in rate or whether they merely partake of the character of atmospheric vagaries, and are not reducible to any law. Long-continued observations of the markings may also furnish useful evidence as to their durations as visible objects, and also on the question of possibly recurrent outbreaks in certain latitudes after intervals of comparative quiescence.

As a contribution to a consecutive history of this planet's mobile phenomena, I have compiled the following summary of mean rotation periods computed from observations at Bristol, extending over the five years 1898 to 1902 inclusive, with a 10-inch Browning-With reflecting telescope and one of Steinheil's "monocentric micrometer oculars" of $\frac{1}{4}$-inch equivalent focus, giving a power of 312. Magnifiers of 252, 332, and 488 were occasionally employed, but the one of 312 was usually found the most serviceable and efficient.

During the five years named the planet was placed south of the equator (in 1900 and 1901 from $19\frac{1}{2}^\circ$ to $23\frac{1}{2}^\circ$ S.), and therefore in an unfavourable position for European observers. The suburb of Bishopston, from which my observations were made, lies due north of Bristol, so that the definition was sometimes much impaired by the situation of *Jupiter* immediately over the centre and amid the vapours of a populous city.

To what extent low altitude affected the telescopic images may be judged from the following figures. The planet was examined on 328 nights, and on 292 of these a note was made as to the quality of the seeing.

Definition very good	25	nights.
Good	52	,,
Fair	66	,,
Bad	93	,,
Very bad	56	,,

It would be premature to discuss the results fully, but it may be mentioned that during the five years the mean rotation periods of the markings varied as under :—

	h m s		h m s
Equatorial spots	9 50 $23\frac{1}{2}$	to	9 50 29
N. tropical spots	9 55 $26\frac{1}{2}$	to	9 55 $31\frac{1}{2}$
N. and N.N. temperate spots	9 55 50	to	9 55 $56\frac{1}{2}$
S. temperate spots	9 55 $18\frac{1}{2}$	to	9 55 $20\frac{1}{2}$
Great red spot	9 55 42	to	9 55 39

The great red spot, after exhibiting a retarded rate of velocity between 1878 ($9^h\ 55^m\ 33^s{\cdot}7$) and 1899 ($9^h\ 55^m\ 41^s{\cdot}9$), showed evident signs of acceleration in 1900. This became more strongly pronounced in 1901, during which year the object retained a stationary longitude (45°) relatively to System II. of Marth-Crommelin's ephemerides based on a period of $9^h\ 55^m\ 40^s\ 63$. The acceleration further developed in 1902, and brought about a reduction in the rotation period of 3 seconds as compared with that in 1899, and the longitude of the spot on 1902 December 31 became 36°·3. This marking has presented an exceedingly faint, though somewhat variable, aspect in recent years, and its oval shape has only been discernible under the best conditions. For this reason satisfactory transits are not often obtainable, but a good substitute is found in the conspicuous hollow or bay on the S. side of the great S. equatorial belt, which has precisely the same longitude and rate of velocity as the red spot, and is undoubtedly very closely connected with that object.

It should be remarked that the differences in the rotation periods shown in the above table are the means derived from several objects in the same current. The individual objects exhibited larger discordances, for even at the same period the rate of motion of a current is very far from being equable throughout its circumference. To show how far this is the case it will be sufficient to give the extreme differences in rotation period observed in regard to the equatorial spots in four years :—

Summary of mean Rotation Periods of the Principal Mark-

Description of Markings.	Approximate Latitude.	1898. Rotation Period.	1898. No. of Spots.	1899. Rotation Period.	1899. No. of Spots.
	° °	h m s		h m s	
N.N. temperate spots	+40 to +25	9 55 50·1	2	9 55 29·8	1
N. temperate spots ...				9 55 53·5	1
N. tropical spots ...	+14	9 55 26·3	3	9 55 28·8	16
Equatorial spots S. side N. belt ...	+ 6	9 50 26·8	1	...	
Equatorial spots N. side S. belt ...	− 5	9 50 23·6	23	9 50 24·6	27
Great red spot ...	−20	9 55 41·8	1	9 55 41·9	1
S. temperate spots ...	−27 to −33	9 55 20·5	4	9 55 18·6	3
S.S. temperate spots ...	−35 to −40	9 55 14·0 (2)		9 55 9·2	2
		9 55 8·6 (2)			
Date of observations ...		Mar.–July		June–Sept.	
Nights of observation ...		51		76	
Transits recorded ...		280		668	

	Spot with Minimum Period. h m s	Spot with Maximum Period. h m s	Difference. sec.
1898	9 50 16·9	9 50 33·2	16·3
1899	9 50 18·0	9 50 35·0	17·0
1901	9 50 25·1	9 50 35·0	9·9
1902	9 50 24·4	9 50 29·1	4·7

From these figures it would appear that the velocity of the equatorial current displayed a more even rate generally in 1902 than in 1898 and 1899.

During the last few years I have frequently looked for a return of the rapidly moving spots observed in the N. temperate belt of *Jupiter* in 1880 and 1891, but have not certainly succeeded in recovering them. Both in 1901 and 1902 the region of the planet in about N. latitude 25°–40° exhibited a very disturbed condition, and dark spots were abundant; but as far as could be observed they were all controlled by a very slow rate of motion. Confused definition and periods of unfavourable weather, however, prevented some of these markings from being followed as satisfactorily as could have been wished. On 1902 November 18 I observed two well-defined dark spots (also seen by the Rev. T. E. R. Phillips at Croydon) in the N. temperate region, the f. one of which occupied same longitude as the centre of the red spot hollow. A week later—on November 25—the two spots were missing: they had either moved rapidly westwards or disappeared altogether; but much unfavourable weather followed, and the objects alluded to were never seen again.

ings on Jupiter in the years 1898 *to* 1902 *inclusive.*

1900. Rotation Period. h m s	1900. No. of Spots.	1901. Rotation Period. h m s	1901. No. of Spots.	1902. Rotation Period. h m s	1902. No. of Spots.
} ...	...	9 55 50·2	6	9 55 56·5	9
9 55 30·0	17	9 55 31·6	1	9 55 29·8	10
...	...	...	...	9 50 28·5	1
9 50 24·1	18	9 50 29·1	28	9 50 26·7	24
9 55 41 7	1	9 55 40·9	1	9 55 39·0	1
...	...	9 55 19·7	1	9 55 18·7	7
...	...	...	...	...	...

1899 Dec.–1900 Mar.	May–Nov.	1902 June–1903 Jan
36	76	89
307	547	1005

Of the total number (2,807) of transits 1,855 were of equatorial spots, while 952 were of other markings. The spots immediately south of the equator are generally more abundant and conspicuous than those lying north of it.

Bishopston, Bristol:
1903 *March* 18.

On the Orbit of Σ 2525. By W. Bowyer.

(*Communicated by W. H. M. Christie.*)

This star is

B.D. +27°, No. 3391, R.A. $19^h\ 22^m\ 30^s$, N.P.D. 62° 52′ } 1900

Mags. 7·5 and 7·7 (Σ)

In vol. liii., *Monthly Notices*, 1892 November, Mr. Gore computed an orbit of this double star from the observations extending from 1828 to 1892, the period obtained being 138·5 years.

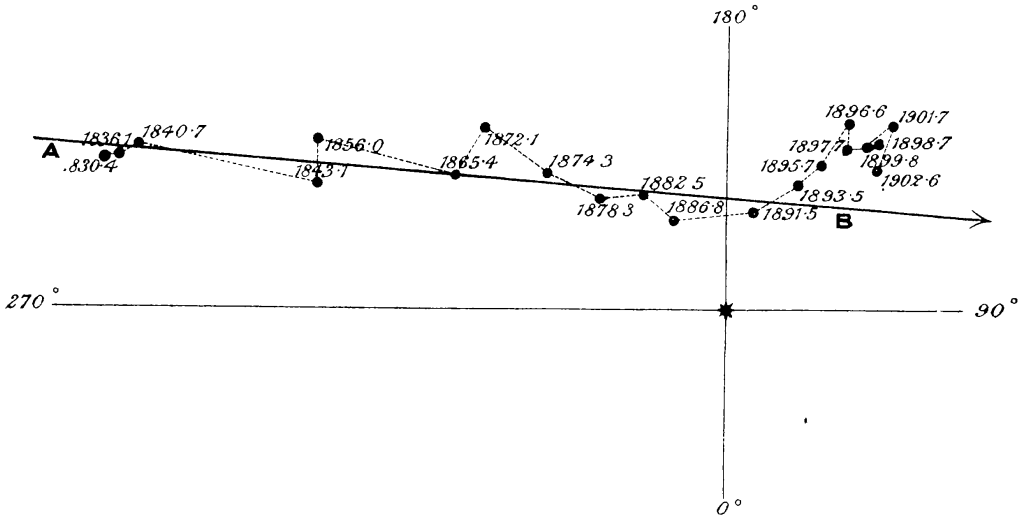
This orbit was merely intended to draw attention to the pair, for the material at Mr. Gore's command was really insufficient to discriminate between orbital and rectilinear motion, the observation of H. Struve in 1889 not being then published. The magnitudes of the components being so nearly equal, it was impossible to tell from the observations of 1886, 1891, 1892, whether the secondary star had swept through the two quadrants 180° to 0° and had reached the fourth quadrant in 1891·5, or whether it had simply continued its motion from A to B, as shown in fig. 1.

For the purposes of the present paper all available observations have been collected. The measures being in general somewhat discordant, it seemed advisable to group them, giving weights according to the number of nights. The mean places are shown in the following table. The abbreviations used are :—

Σ, W. Struve; OΣ, O. Struve; HΣ, H. Struve; Dem., Dembowski; Schiap., Schiaparelli.

Date.	Position Angle.	Distance.	Observer and Number of Nights.
	°	″	
1830·43	255·9	1·33	Σ 5.
1836·14	255·5	1·30	Σ 2.
1840·67	253·5	1·27	Dawes 1, OΣ 2.
1843·06	252·5	0·89	Maedler 2.
1855·95	247·0	0·92	OΣ 1, Secchi 2.
1865·39	243·0	0·63	Dem. 7, OΣ 2, Engelmann 1, Secchi 1.

Σ 2525
FIG. 1.



Σ 2525 (Apparent Ellipse)
FIG. 2.